MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2018/2019

PCM0016 – CHEMISTRY

(All sections / Groups)

11 MARCH 2019
2.30 p.m – 4.30 p.m
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 4 pages only excluding the cover page.
2. Attempt **ALL** questions. Distribution of the marks for each question is given.
3. Please write all your answers in the answer booklet provided.

QUESTION 1 [20 MARKS]

(a) Complete the table below by writing the chemical formulae, naming the compounds and identify the compounds as ionic or molecular:

Chemical formula	Name of compound	Ionic or molecular?
$CoCl_2 \cdot 6H_2O$	(i)	(ii)
(iii)	Dinitrogen monoxide	(iv)

[2 marks]

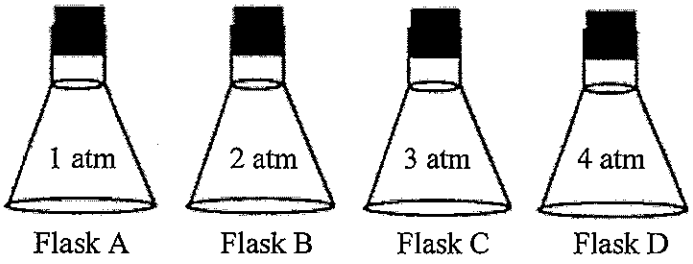
(b) Formic acid, $HCHO_2$, burns in oxygen to form carbon dioxide as the equation below:

$$2\ HCHO_2\ (aq) + O_2\ (g) \rightarrow 2\ CO_2\ (g) + 2\ H_2O\ (l)$$

At STP, a 4.5 g sample of formic acid was burnt in 2.0 L of oxygen. Find:
[Atomic mass: H = 1.0; C = 12.0; O = 16.0]

(i) the limiting reagent. [2 marks]
(ii) the maximum volume of carbon dioxide would be produced. [1 mark]

(c) Figure below shows four flasks of same size at different pressure. Assuming the temperature is similar, answer the following questions:



(i) Which flask contains the most molecules? Briefly explain. [1 mark]
(ii) How to increase pressure in Flask B? [1 mark]

(d) For the following statements, state whether it is true or false.

Statement	True/ False
An open system is a system that freely exchanges energy and matter with its surroundings.	(i)
Temperature is not a measure of thermal energy	(ii)
Entalphy of products is always lesser than of the reactants in an exothermic reaction	(iii)

[1.5 marks]

Continued...

(e) Anhydrous aluminum chloride sublimes at high temperatures. Calculate the density of the vapor at 220 °C and 0.9 atm.
[Molecular mass of aluminum chloride is 133.3 g/mol; the universal gas constant, R = 0.08206 L.atm/mol.K] [1.5 marks]

(f) In a room at 18 °C, a spherical balloon had the diameter of 24.0 cm. When taken outside the balloon expanded to 25.0 cm in diameter. Calculate the temperature outside in Kelvin. (Assume that the balloon is a perfect sphere and that the pressure and number of moles of air molecules remains the same).
[Volume of sphere $= \frac{4}{3}\pi r^3$] [2 marks]

(g) Use Hess's law to determine ΔH_f^o for the combustion of methanol:

$$2\ Al\ (s) + 3\ Cl_2\ (g) \longrightarrow 2\ AlCl_3\ (s) \qquad \Delta H_f^o = ?$$

Given:

Equations	ΔH_{rxn}^o **(kJ)**
$2\ Al\ (s) + 6\ HCl\ (aq) \longrightarrow 2\ AlCl_3\ (aq) + 3\ H_2\ (g)$	-1049.0
$HCl\ (g) \longrightarrow HCl\ (aq)$	-74.8
$H_2\ (g) + Cl_2\ (g) \longrightarrow 2\ HCl\ (g)$	-1845.0
$AlCl_3\ (s) \longrightarrow AlCl_3\ (aq)$	-323.0

[2.5 marks]

(h) Answer the following questions about the Periodic Table:

(i) Write the valence configuration for an element of group 14, period 3. [1 mark]
(ii) State the group and period of an element that has maximum $3d^2$ electron arrangement. [1 mark]

(i) Write the ground state electron configuration for chromium, $^{24}_{52}Cr$. Also, state the number of unpaired electrons. [1.5 marks]

(j) Explain the relationship between the relative size of an ion to its atom. [2 marks]

QUESTION 2 [15 MARKS]

(a) Draw the Lewis diagram for hydrogen cyanide, HCN and predict its shape. [1.5 marks]

(b) Draw the orbital overlap of the hybridization of C_2H_4 (label all the bonds). [2.5 marks]

Continued...

(c) The following are covalent molecules of different polarity. Determine if they are polar or non-polar and state the type of intermolecular forces between the molecules.

Molecule	Polarity	Intermolecular forces
(i) Hydrogen fluoride		
(ii) Methane		

[2 marks]

(d) The triple point of iodine is 115 °C at 12 atm.
(i) Define triple point. [1 mark]
(ii) Sketch the phase diagram of iodine. [1.5 marks]
(iii) Explain what happens if some solid iodine is heated under room conditions. [0.5 mark]

(e) The symbols of six particles are shown below.

Na^+, Ca^{2+}, K, P, Si, O^{2-}

Select from the list of particles to answer the following questions:
(i) Which two ions are isoelectronic? [1 mark]
(ii) Which atom can form a hydride which has a formula of XH_4? [1 mark]

(f) Briefly explain simple cubic unit cell. State the coordination number of it and compare the distance of the spheres in cubic unit cell and body-centered cubic unit cell. [2 marks]

(g) Magnesium and calcium are in the same group of the Periodic Table. Compare the first ionization energy of both elements. [2 marks]

QUESTION 3 [15 MARKS]

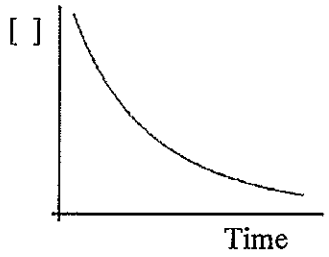
(a) When nitrosyl chloride, NOCl, is heated, it dissociates reversibly into nitric oxide, NO, and chlorine, Cl_2, according to the equation:

$$2\ NOCl\ (g) \rightleftarrows 2\ NO(g) + Cl_2(g)$$

(i) Write the expression for the equilibrium constant, K_p, for this reaction. [1 mark]
(ii) If the reaction is endothermic, state the effect of an increase in temperature on the value of the equilibrium constant, K_p. [1 mark]
(iii) If chlorine is increased, suggest in which direction the position of equilibrium will move. [0.5 mark]

Continued...

(b) Using the same chemical equation of heating of NOCl in (a) above, write the rate law for the forward reaction and state the unit for the rate constant, k. Assume that the shape of the concentration–time graph for the forward reaction follows the graph below. [1.5 marks]



(c) Ammonium chloride, when dissolved in water produces NH_4^+ that act as a weak acid as shown by the equation:

$$NH_4^+ (aq) \rightleftarrows NH_3 (aq) + H^+ (aq)$$

If the pH of this reaction is 11.8,

(i) calculate the concentration of hydroxide ions. [1 mark]
(ii) find the initial concentration of NH_4^+ if the K_a is 3.15×10^{-10}. [2.5 marks]

(d) $HClO_2$ and $HClO_3$ are two examples of oxoacids. Pick which acid is having stronger acidity and specify your reason. [1 mark]

(e) In a lab, a student performed an electrolysis of molten $PbBr_2$ using graphite as the electrodes.

(i) Draw the experimental set up of the experiment. [2 marks]
(ii) Write half-equations at anode and cathode. [1 mark]

(f) Calculate the volume of hydrogen produced (measured at room temperature and pressure - RTP) during the electrolysis of dilute sulfuric acid if you use a current of 1.0 A for 15 minutes.
[Atomic mass: H = 1.0; Molar volume of a gas at RTP = 24 L/ mol; Faraday constant = 96500 C/mol e^-] [2 marks]

(g) Complete the sentences below:

To make a ____(i)____ M NaOH (Molar mass = 40 g/mol) solution, we ____(ii)_____ 40 g NaOH to a total volume of 2 L in water.

In another case, to prepare 50 ml of a 1.0 M solution from a 2.0 M stock solution, you pour ____(iii)____ ml of stock solution into a 50 ml volumetric flask (to 50 ml line). [1.5 marks]

End of Paper